PATENT ABSTRACTS OF JAPAN

(11)Publication number : **2000-080440**
(43)Date of publication of application : **21.03.2000**

(51)Int.Cl. C22C 38/00
C21D 9/46
C22C 38/12
C22C 38/58

(21)Application number : **10-246175**
(22)Date of filing : **31.08.1998**

(71)Applicant : **KAWASAKI STEEL CORP**
(72)Inventor : **TOSAKA AKIO**
KANEMOTO NORIO
MEJIKA SETSUO
UCHIYAMA TAKAO

(54) HIGH STRENGTH COLD ROLLED STEEL SHEET AND ITS MANUFACTURE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a high strength cold rolled steel sheet having ≥780 MPa tensile strength and ≥70 MPa amount of baking hardening and combining excellent stretch-flange formability, spot weldability, delayed fracture resistance, and impact resistance.
SOLUTION: A steel stock, having a composition in which 1.5-3.5%, by weight, Mn and 0. 005-0.10% Nb are contained and further the amounts of C, Si, P, S, Al, and N are regulated to proper values, respectively, is heated to a temperature at which the amount of Nb unentered into solid solution becomes ≥0.003%, finish rolled at 950 to 800°C finish rolling delivery-side temperature, coiled at 700 to 400°C coiling temperature, and cold rolled. The resultant steel sheet is annealed at ≥800°C annealing temperature, rapidly cooled continuously down to ≤350°C at (15 to 150)°C/s cooling rate, cooled slowly down to ≤200°C at ≥15°C/min cooling rate, and then cooled rapidly down to room temperature. By this procedure, a structure composed essentially of fine bainitic structure of ≤2.5 μm average grain size is provided.

Claim(s)]
[Claim 1]By weight %, C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, below S:0.005 %, and below aluminum:0.150 %. N:0.0200% or less, Nb : 0.005 to 0.10% is contained, It consists of an organization which has the presentation which consists of the remainder Fe and inevitable impurities, and is mainly concerned with a

detailed bainite texture below average crystal grain diameter:2.5 mum, Tensile strength: High intensity cold-rolled steel sheets excellent in weldability, stretch-flanging nature, the delayed fracture-proof characteristic, and a shock resistant characteristic having 780 or more MPa and more than amount (amount of BHs):of paint baking hardening70MPa.
[Claim 2]said presentation -- in addition -- further -- weight % -- Ti: -- the high intensity cold-rolled steel sheets according to claim 1 containing one sort in V:0.005 - 0.050 %, or two sorts or more : [0.005 to 0.20% of] B:0.0005 to 0.0040%.
[Claim 3]In addition to said presentation, by weight % further More than Cu:0.02% and more than nickel:0.02%. Cr: More than 0.02%, Mo: The high intensity cold-rolled steel sheets according to claim 1 or 2 below 1.0 % containing Ca:0.0005-0.0050% for one sort chosen from 0.02% or more of inside, or two sorts or more in total.
[Claim 4]By weight %, C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, below S:0.005 %, and below aluminum:0.150 %. N:0.0200% or less, Nb : steel stock of a presentation containing 0.005 to 0.10%, Heat to temperature from which the amount of undissolved Nb(s) becomes more than 0.003 %, perform hot-rolling including finishing rolling with which the finishing rolling appearance side temperature serves as a temperature requirement of 950 - 800 **, and it is considered as a hot-rolled board, Rolling-up temperature : After rolling round by 700 - 400 **, cold-rolling subsequently to said hot-rolled board and considering it as a cold-rolled board, Give annealing to this cold-rolled board with annealing temperature more than 800 **, and it quenches from this annealing temperature continuously to temperature of more than below 350 **200 ** with a cooling rate of 15 - 150 **/s, Tensile strength carrying out slow cooling to temperature below 200 ** with a cooling rate 15 ** / more than min after that : 780 or more MPa, The amount of paint baking hardening (the amount of BHs): A manufacturing method of high intensity cold-rolled steel sheets which have 70 or more MPa and were excellent in weldability, stretch-flanging nature, the delayed fracture-proof characteristic, and a shock resistant characteristic.

==========

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention is used for parts which absorb a shock effectively at the time of the collision manufactured through shaping of slight draw forming, bending, roll forming, etc. among autoparts, such as an impact beam and a bumper, and suitable tensile strength is related with high intensity cold rolled sheet steel of 780 or more MPa, and a manufacturing method for the same. The steel plate as used in the field of this invention shall contain the steel plate and steel strip in coil which performed electroplating and hot-dip coating to these steel plates further also including a steel strip in coil.
[0002]
[Description of the Prior Art]In recent years, use of the high strength steel sheet to autoparts is strongly demanded for the improvement in safety of a car, and the weight saving of a body weight. Although the high intensity exceeding 590MPa is demanded of the steel plate used for the bumper parts used in order to control modification of a cabin especially at the time of a collision, an impact beam, etc. also from the former, In order to attain the demand of the thinning by high-intensity-izing, it is requested that tensile

strength has 780 or more MPa further. In addition to having high intensity, local ductility, i.e., bend and excel in a moldability or the characteristic corresponding to stretch flanging workability, is further required of the steel plate used for bumper parts, an impact beam, etc.

[0003]It is required that it should have the outstanding spot welding nature -- autoparts are assembled by spot welding in many cases, and its spot welding part joint strength is high to these steel plates. Depending on parts, not only spot welding but TIG arc welding, metal active gas arc welding, laser welding, etc. may be applied, and to have the outstanding welding workability and the mechanical property of a joint part on the occasion of these welding is also desired.

[0004]The latest automotive body structure sets weight to a passenger's improvement in safe, and has been changing.

The high thing of the energy absorbing capacity at the time of a collision, i.e., a shock resistant characteristic, serves as the very important characteristic.

This shock resistant characteristic is the important characteristic also not only in base metal but in the weld zone.

It is necessary to have a high collision energy absorption feature like a base-metal part also in a weld zone.

[0005]Thus, the steel plate used for bumper parts, an impact beam, etc. has disclosed the manufacturing method of the high intensity steel plate which excelled [manufacturing method / of the high intensity steel plate with ductility and processability good to JP,59-143027,A and JP,60-100630,A] in elongation flange nature again at JP,H7-188767,A, for example in order to obtain the high intensity steel plate made into ** high intensity and the target for to have ** local ductility, ** weldability, and ** shock resistant characteristic further to be desired. The method indicated to JP,59-143027,A, The heating rate by 600 ** - Ac_3 transformation point is carried out for a steel plate in not less than 5 **/[s and], After heating to the soaking temperature more than Ac_3 transformation point, it holds between 10 sec - 10 min at the temperature, Subsequently, give annealing which cools the average cooling rate for 600-300 ** above the critical cooling rate to which it is specified by alloy element content, and as a mixed organization of a ferrite and the bainite containing one copy of martensite, It is considered as the high intensity more than 60kgf/mm^2, and the steel plate which has the outstanding processability.

[0006]The method indicated to JP,60-100630,A, After heating a steel plate to the following soaking temperature more than Ac_3 transformation point (+50 ** of Ac_3 transformation points) and holding it for 60 sec 3 sec - at the temperature, Cool to the temperature requirement between Ar_3 transformation point and Ar_1 transformation point, and it holds 20 sec or more in the temperature requirement, 600 - annealing which cools the average cooling rate between 300 ** above the critical cooling rate to which it is specified by alloy element content, [give and] It is considered as the mixed organization of a ferrite and martensite containing one copy of bainite, and is considered as the high intensity more than 70kgf/mm^2, and the steel sheets which have the outstanding processability.

[0007]The method indicated to JP,H7-188767,A, After annealing a steel plate between 20 sec - 5min at the temperature below 900 ** more than an Ar_3 transformation point, 600 As an organization which keeps warm or reheats [cool quickly and] from the

temperature more than ** between 1 - 30min at the temperature of 200 - 400 ** continuously to 200 - 300 ** with the cooling rate at 100-500 **/s, and makes bainite a subject, **** strength considers it as high intensity cold rolled sheet steel excellent in the elongation flange nature more than 780N/mm^2.

[0008]However, in the steel plate manufactured by the technology indicated to JP,59-143027,A, JP,60-100630,A, and JP,H7-188767,A. It was difficult to satisfy all of four sorts of characteristics, ** high intensity and ** local ductility which are required of the steel plate used for bumper parts, an impact beam, etc., ** weldability, and ** shock resistant characteristic. For example, the method indicated to JP,59-143027,A and JP,60-100630,A, Although high intensity is obtained by comparatively little alloy element addition by forming the mixed organization of a ferrite phase and low-temperature transformation organizations (martensite, bainite, etc.) and it is going to be compatible in processability and high intensity-ization, Considering it as the mixed organization of a phase which differs in such processability itself caused a local ductility fall.

[0009]Since it is low, the yield strength (YS) of base metal becomes disadvantageous about the parts of the use than to which greater importance is attached to the absorbed energy to a small distortion area. Welding of spot welding etc. will produce softening of a heat affected zone, i.e., the strength reduction of a heat affected zone. This poses a problem important not only the case of static loading but in the case of shocking loading. When a hard low-temperature transformation organization distributes in a ferrite phase, in order that it may become what is called band structure in many cases and a crack may spread easily along this organization, there is a problem that the delayed fracture characteristic falls.

[0010]When the method of considering it as the organization which adds tempering treatment and makes bainite a subject is adopted after quenching with the cooling rate which matches after annealing at water quenching or it so that it may be indicated to JP,H7-188767,A, High intensity is obtained with comparatively little alloy elements, and a uniform organization can be obtained theoretically. However, there was a fault of it having been difficult to keep a quenching rate actual to homogeneity over the whole hot-rolled steel strip in coil by a manufacturing process (distribution arises especially in a plate width direction), and its dispersion in the construction material by a part having been large, and becoming a cause of the defect of shape at the time of press forming. Since [about 100 - 300 **] it is short-time processing in a low temperature region comparatively, tempering treatment required for processability reservation also expands the unevenness of construction material further in actual process production.

[0011]Naturally the unevenness of such construction material had brought about deterioration of average construction material as a result also through dispersion in various characteristics, such as local ductility. Since the increase in intensity was aimed at with quenching, when spot welding etc. were welded, the heat affected zone softened remarkably and there were static and a problem that dynamic strength fell. Since the old austenite grain boundary served as a starting point of a crack of delayed fracture, or a propagation path of a crack easily, there was a problem that the delayed fracture-proof characteristic was very low.

[0012]

[Problem to be solved by the invention]It is the presentation which this invention solves the above-mentioned problem and consists of a comparatively low alloy addition, The

moldability which has the tensile strength which exceeds 780 MPa, and was excellent in stretch-flanging nature, bending nature, etc., The good weldability in spot welding etc. and a base-metal part aim at proposing the high intensity cold rolled sheet steel which has the outstanding shock resistant characteristic which has the impact strength absorption feature which agreed about intensity also in the weld zone from the first.

[0013]An object of this invention is to propose the steel plate which in addition to the above-mentioned characteristic has high paint baking hardenability in order to be able to reduce the load at the time of shaping and to obtain sufficient part intensity, and has the characteristic which was excellent further also about the delayed fracture-proof nature which often poses a problem with high-strength steel. The main uses of the steel plate of this invention are the reinforcement members of the car used for light processing, such as bumper parts and an impact beam, being given.

[0014]

[Means for solving problem]In order that this invention persons may attain above-mentioned SUBJECT, as a result of carrying out intermediary **** examination, to a steel plate presentation and a manufacturing process A presentation, It found out that the steel plate which is high intensity and had local ductility, weldability, and a shock resistant characteristic could be manufactured by considering an organization as the organization which is mainly concerned with the uniform and detailed bainite below average crystal grain diameter 2.5 mum by making hot-rolling conditions and cold-rolled board annealing conditions into an appropriate range. As for this invention persons, it is effective in improvement in the form and dimensional accuracy of a steel plate to apply the continuous rolling technology which joins and rolls the sheet bar preceded with finishing rolling of hot-rolling and the sheet bar which carries out backward, The effective thing also carried out the knowledge of equalizing steel plate temperature a longitudinal direction and crosswise simultaneously using sheet bar edge heaters and a sheet bar heater, and masking cooling water further at the crosswise edge part of a steel plate, and preventing the supercooling of edge to equalization of construction material.

[0015]This invention is constituted based on the above-mentioned knowledge. This invention is weight % and Namely, C:0.05 to 0.30%, and below Si:1.0 %. Mn: 1.5 - 3.5 %, P:0.02% or less, and below S:0.005 %. aluminum: Below 0.150 %, N:0.0200% or less, Nb : 0.005 to 0.10% is contained, It consists of an organization which has the presentation which consists of the remainder Fe and inevitable impurities, and is mainly concerned with the detailed bainite texture below average crystal grain diameter:2.5 mum, Tensile strength :. It is characterized by having 780 or more MPa and more than amount (amount of BHs):of paint baking hardening70MPa. Are high intensity cold-rolled steel sheets excellent in weldability, stretch-flanging nature, the delayed fracture-proof characteristic, and a shock resistant characteristic, and in this invention. In addition to said presentation, by weight % further Ti:0.005 -0.20%, It is preferred to contain 1 of B:0.0005 to 0.0040% and V:0.005 to 0.05% of sorts and two sorts or more, and, in addition to said presentation, it is weight % further, Cu: More than 0.02%, more than nickel:0.02%, more than Cr:0.02%, Mo: Below 1.0 % may contain Ca:0.0005-0.0050% for one sort chosen from 0.02% or more of inside, or two sorts or more in total.

[0016]This invention is weight % and C:0.05 to 0.30%, and below Si:1.0 %. Mn: 1.5-3.5 %, P:0.02% or less, and below S:0.005 %. aluminum: Below 0.150 %, N:0.0200% or less, Nb : 0.005 to 0.10% is included, The temperature from which the amount of

undissolved Nb(s) becomes more than 0.003 % about the steel stock of the presentation which consists of the remainder Fe and inevitable impurities, Heat at 1150 ** or less preferably, perform hot-rolling including finishing rolling with which the finishing rolling appearance side temperature serves as a temperature requirement of 950 - 800 **, and it is considered as a hot-rolled board, Rolling-up temperature : After rolling round by 700 - 400 **, cold-rolling subsequently to said hot-rolled board and considering it as a cold-rolled board, Give annealing to this cold-rolled board with the annealing temperature more than 800 **, and it quenches from this annealing temperature continuously to the temperature of more than below 350 **200 ** with the cooling rate of 15 - 150 **/s, Tensile strength carrying out slow cooling to the temperature of 200 ** or less with the cooling rate 15 ** / more than min after that : 780 or more MPa, The amount of paint baking hardening (the amount of BHs): It is a manufacturing method of the high intensity cold-rolled steel sheets which have 70 or more MPa and were excellent in weldability, stretch-flanging nature, the delayed fracture-proof characteristic, and a shock resistant characteristic. In this invention, are the presentation of said steel stock weight %, and C:0.05 to 0.30%, Si: Below 1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, S: Below 0.005 %, below aluminum:0.150 %, N:0.0200% or less, Nb : Including 0.005 to 0.10%, further Ti:0.005 -0.20%, B:0.0005 to 0.0040%, it is good also as a presentation which contains one sort in V:0.005 - 0.050 %, or two sorts or more, and consists of the remainder Fe and inevitable impurities, and the presentation of said steel stock by weight %. C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, below S:0.005 %, and below aluminum:0.150 %. N:0.0200% or less, Nb : 0.005 to 0.10% is included, Furthermore, more than Cu:0.02%, more than nickel:0.02%, and more than Cr:0.02%. Mo : It is good also as a presentation as for which below 1.0 % contains in total one sort chosen from 0.02% or more of inside, or two sorts or more and which consists of the remainder Fe and inevitable impurities, and the presentation of said steel stock by weight % C:0.05 to 0.30%, and below Si:1.0 %. Mn: 1.5 - 3.5 %, P:0.02% or less, and below S:0.005 %. aluminum: Below 0.150 %, N:0.0200% or less, Nb : 0.005 to 0.10% is included, It is good also as a presentation which furthermore contains Ca:0.0005-0.0050% and consists of the remainder Fe and inevitable impurities, and the presentation of said steel stock by weight %. C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, below S:0.005 %, and below aluminum:0.150 %. N:0.0200% or less, Nb : 0.005 to 0.10% is included, Furthermore, Ti:0.005 -0.20%, B:0.0005 to 0.0040%, V: Contain one sort in 0.005 - 0.050 %, or two sorts or more, Furthermore, more than Cu:0.02%, more than nickel:0.02%, and more than Cr:0.02%. Mo : It is good also as a presentation as for which below 1.0 % contains in total one sort chosen from 0.02% or more of inside, or two sorts or more and which consists of the remainder Fe and inevitable impurities, and the presentation of said steel stock by weight %. C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, S: Below 0.005 %, below aluminum:0.150 %, N:0.0200% or less, Nb : Including 0.005 to 0.10%, further Ti:0.005 - 0.20%, One sort in V:0.005 - 0.050 % or two sorts or more are included B:0.0005 to 0.0040%, It is good also as a presentation which furthermore contains Ca:0.0005-0.0050% and consists of the remainder Fe and inevitable impurities, and the presentation of said steel stock by weight %. C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, below S:0.005 %, and below aluminum:0.150 %. N:0.0200% or less, Nb : 0.005 to 0.10% is included, Furthermore, more than Cu:0.02%, more than nickel:0.02%,

and more than Cr:0.02%. Mo : In total one sort chosen from 0.02% or more of inside, or two sorts or more Below 1.0 %. Ca : It is good also as a presentation which contains 0.0005 to 0.0050% and consists of the remainder Fe and inevitable impurities, and the presentation of said steel stock by weight % C:0.05 to 0.30%, below Si:1.0 %, Mn:1.5 - 3.5 %, P:0.02% or less, S: Below 0.005 %, below aluminum:0.150 %, N:0.0200% or less, Nb : Including 0.005 to 0.10%, further Ti:0.005 -0.20%, 1 of B:0.0005 to 0.0040% and V:0.005 to 0.050% of sorts and two sorts or more are included, Furthermore, more than Cu:0.02%, more than nickel:0.02%, and more than Cr:0.02%. Mo: It is good also as a presentation as for which below 1.0 % contains Ca:0.0005-0.0050% in total and which consists of the remainder Fe and inevitable impurities one sort chosen from 0.02% or more of inside, or two sorts or more.

[0017]In [it is preferred to consider it as continuous rolling which joins the sheet bar which precedes said finishing rolling by the finishing mill ON side, and the sheet bar which carries out backward in this invention, and is rolled continuously, and] said finishing rolling at this invention, It is desirable and it is preferred to consider said finishing rolling as lubricous rolling with which using sheet bar edge heaters, one side of a sheet bar heater, or both by the finishing mill ON side uses a lubricating oil.

[0018]

[Mode for carrying out the invention]The target steel plate [this invention] is cold rolled sheet steel of 2.0 mm or less of board thickness. When board thickness becomes thick exceeding 2.0 mm, a cooling rate after annealing falls, with a cooling rate which is a gas-jet grade, target high intensity is hard to be obtained and there is a problem which was already described by cooling by powerful cooling methods, such as water quenching. When board thickness exceeds 2.0 mm, there are few advantages which can be manufactured more inexpensive and manufactured with cold rolled sheet steel with hot-rolling.

[0019]Tensile strength is high intensity cold rolled sheet steel which has 780 or more MPa, and this invention steel plate is a steel plate in which the amount of baking hardening (the amount of BHs) has 70 or more MPa. Although a maximum in particular of tensile strength is not specified, even 1480MPa which is the intensity for which a steel plate is used shall be included. Below, a Reason for limitation of component composition of this invention steel plate is explained.

[0020]C:0.05 to 0.30%C is an austenite stabilization element, and acts effective in transformation organization strengthening. Transformation organization strengthening is accepted by 0.05% or more of content. On the other hand, content exceeding 0.30% reduces weldability notably -- a nugget part of spot welding hardens remarkably. When load especially of the impact is carried out, a danger that a weld zone will fracture by low energy-absorbing below a value expected increases. A maximum of C was made into 0.30% from a viewpoint of a shock resistant characteristic. Since it was such, C was limited to 0.05 to 0.30% of range. It is preferred to consider it as 0.20% or less from a viewpoint of it being stabilized and obtaining high tractive characteristics and weldability.

[0021]Si: Below 1.0 %Si is an element which raises resistance to temper softening, and make it below 1.0 % contain in this invention. 1.0 Content exceeding % makes deformation resistance between heat of steel increase notably, and it becomes difficult to hot-roll it of thin material. It is desirable, as for Si, for below 0.8 % to carry out in a use

from which surface scale nature surface discontinuity poses a problem. As for a viewpoint of a cleanliness improvement of steel to Si, it is desirable to make it contain 0.01% or more.

[0022]Mn: 1.5 - 3.5 %Mn needs to combine with S, and it is necessary to add it according to the amount of S which is an effective element which prevents hot tearing by S, and is contained. Mn has the operation which miniaturizes a crystal grain and it adds positively in this invention. Mn makes a low-temperature transformation phase which raises the hardenability of steel and is mainly concerned with bainite generate, and high-intensity-izes steel notably. In order to manufacture a high intensity cold-rolled product sheet which has 780 or more MPa of tensile strength, as for Mn, content more than 1.5 % is needed. On the other hand, deformation resistance between heat increases and it becomes increase of rolling load is remarkable and difficult to hot-roll content exceeding 3.5%. Intensity of a hot-rolled board increases and trouble arises also at a cold-rolled process. Content of Mn exceeding 3.5 % also has problems, such as degradation of weldability, and a fall of the moldability of a weld zone. Since it was such, Mn was limited to the range of 1.5 - 3.5 %. As for a viewpoint of corrosion resistance and a moldability to Mn, it is preferred that below 3.2 % carries out.

[0023]P:0.02%or less P makes steel make it hard, and degrades the stretch flanging workability of a steel plate. Tendency of P which carries out a segregation to a board thickness center section of the steel plate in continuous casting material is strong, and it embrittles a weld zone. Since it is such, although decreasing as much as possible is desirable as for P, 0.02% can approve by this invention. When thinking stretch flanging workability and weld zone toughness as important, it is desirable to consider it as 0.01% or less.

[0024]S: In steel, below 0.005 % S exists as nonmetallic inclusion, it reduces the ductility of a steel plate, and degrades corrosion resistance further. Since there is a tendency for notch susceptibility to increase in high-strength steel like this invention steel plate, it is necessary to reduce inclusion, such as MnS used as a source of stress concentration. For this reason, although being referred to as low S becomes very important, 0.005 % can approve. It is desirable that below 0.002 % carries out from a viewpoint of processability.

[0025]aluminum: Below 0.150 %aluminum is a useful element which acts as a deoxidizer, and raises cleanliness of steel, and miniaturizes an organization. Although it is dependent on deoxidation technology, the deoxidation effect comes to be preferably accepted notably by 0.01% or more of aluminum addition, and an effect of an organization miniaturization also becomes remarkable further. Since addition exceeding 0.150 % caused degradation of a surface disposition on the other hand and it was connected with steel plate strength reduction, aluminum made 0.150 % a maximum. It is preferred to consider it as the range of 0.010 - 0.080 % from a viewpoint that construction material is stable. Ti, Ca, etc. may be used for aluminum, concomitant use, or aluminum as a deoxidizer, replacing them with. In this case, since that below 0.010 % carries out can attain uniform fine dispersion-ization of an oxide, aluminum is preferred.

[0026]Since the fall of heat slowing nature, the increase in an internal defect, generating of a slab crack at the time of continuous casting, etc. became remarkable when contained so much, N:0.0200%or less N was limited to 0.0200% or less. It is preferred for N from a viewpoint of the stability of construction material, and the improvement in the yield to consider it as 0.0150% or less of range. N has the operation which reduces a

transformation point, and in order to avoid hot-rolling at the temperature of less than Ar_3 transformation point in rolling of the thin material in which rolling temperature falls easily, it is effective to increase N content at 0.0200% or less of within the limits. It is preferred that N considers it as at least 0.0020% or more in this case.
[0027]Nb: 0.005 to 0.10%, by this invention, Nb is an important element, and after it makes a Mn content high, it can be considered as the organization which is mainly concerned with detailed and uniform bainite by adding Nb. In order to consider it as such an organization, Nb needs the content more than 0.005 %. However, in the content exceeding 0.10%, an effect is saturated and also the rolling load at the time of hot-rolling increases. For this reason, Nb was limited to 0.005 to 0.10% of range.
[0028]In addition to the presentation above-mentioned if needed, the following element can be contained in this invention.
one sort Ti:0.005 -0.20%, B:0.0005 to 0.0040%, and in V:0.005 - 0.050 % -- or Ti, B, and V two or more sorts, While all contribute to an organization miniaturization, it is a useful element, when it has the operation which controls the ferrite transformation of steel and a high intensity steel plate is manufactured. Although the miniaturization of an organization is accepted by Ti content more than 0.005 %, 0.0005% or more of B content, or V content more than 0.005 %, The tendency for an effect to be saturated in Ti even if it contains V for B exceeding content or 0.050 % exceeding content and 0.0040% exceeding 0.20% is shown, and the effect of balancing an addition cannot be expected, but it becomes disadvantageous economically. For this reason, it is desirable for B to consider it as 0.0005 to 0.0040% by Ti considering it as 0.005 to 0.20%, and for V to consider it as the range of 0.005 - 0.050 %. Addition of B makes intensity increase remarkably in combination with Nb. Each effect is not offset even if Ti, B, and V carry out compound addition.
[0029]Cu: More than 0.02%, more than nickel:0.02%, Cr : 0.02% or more, Mo: It is an element where each of below 1.0 % Cu, nickel, and Cr and Mo controls a ferrite transformation for one sort chosen from 0.02% or more of inside, or two sorts or more in total and which raises hardenability, and it is a useful element when high-intensity-izing a product sheet by transformation organization strengthening. As for high intensity-ization by such transformation organization strengthening, each element is accepted by 0.02% or more of content. However, a lot of [each element] content made 1.0 % the maximum in the content sum total of Cu, nickel, Cr, and Mo each element in order to cause the increase in the deformation resistance between heat, the increase in the hardenability of a weld zone, or degradation of surface treatment nature (chemical conversion nature, plating nature, etc.).
[0030]Ca: 0.0005 to 0.0050%Ca controls the form of sulfide system inclusion, and contributes to the improvement in ductility of a steel plate. Especially in this invention steel plate which has a bainite texture with high Mn composition, stretch flanging workability is notably improved by Ca addition. Although such an effect is accepted by 0.0005% or more of Ca addition, an effect is saturated, and also the addition exceeding 0.0050% serves as the tendency for a surface disposition to deteriorate, and its danger that the appearance properties after a surface treatment will deteriorate increases. As for this to Ca, it is desirable to consider it as 0.0005 to 0.0050% of range. 0.0010 to 0.0035% of range is more preferred.
[0031]Except the above-mentioned ingredient, the remainders are Fe and inevitable

impurities. As inevitable impurities, less than Sn:0.01% and less than Zn:0.01% are permissible O:0.0070% or less. The organization of this invention steel plate which has the above-mentioned presentation is taken as the organization which is mainly concerned with the detailed bainite texture below average crystal grain diameter:2.5 mum.
[0032]The organization of this invention steel plate may consider it as the organization which makes detailed bainite a main phase, and may contain ferrites other than bainite, martensite, and perlite 10% or less preferably a total of 20% or less by an area rate as a subphase. By making bainite the organization which mainly does, high intensity can be secured, moreover it compares with the tempering martensitic structure of the same intensity, and stretch flanging workability improves notably. in addition -- the bainite as used in the field of this invention refers to the organization where carbide deposited mainly in the Russ boundary or Russ -- tempered martensite -- carbide -- the old austenite grain boundary -- frequency -- the organization which deposited highly is said.
[0033]Although it anneals with bainite and intensity is equivalent to martensite, according to investigation of this inventions, about the elongation flange characteristic, the organizations which make bainite a subject are excellent. This deposits in the old austenite grain boundary in tempering martensitic structure, and is considered that the carbide which moreover deposited big and rough is ****(ing) the adverse effect to stretch flanging workability. Delayed fracture-proof nature and a shock resistant characteristic are remarkably improved by making it the organization which makes bainite a main phase for the same Reason. As for bainite, it is preferred that the big and rough carbide considered to be harmful considers it as what is called little lower bainite organization.
[0034]The organization of this invention steel plate is taken as the fine texture below average crystal grain diameter:2.5 mum. In this invention, measurement of a crystal grain diameter shall be measured about the overall thickness of board thickness. A crystal grain diameter shall be measured about a rolling direction section, and a rolling direction and a rectangular-directions section based on regulation of JIS G 0552, and shall be expressed as those average value. When an average crystal grain diameter considers it as the fine texture below 2.5 mum, stretch flanging workability, delayed fracture-proof nature, and the impact strength absorption feature at the time of high velocity forming are improved notably. Since uniform detailed particle size distribution is mostly maintained even if it receives a weld thermal cycle, also in a weld zone, these characteristics, especially the impact strength absorption feature at the time of high velocity forming are improved notably. As for an average crystal grain diameter, when still higher stretch flanging workability is required, it is desirable that below 2.0 mum carries out. In order to consider it as the organization which made the main phase desirable detailed bainite below 2.0 mum, as already stated, a proper quantity of elements, such as Mn and Nb, are added, and it is [below average crystal grain diameter 2.5 mum] required like the after-mentioned to control properly cooling-after hot-rolling condition annealing and annealing conditions.
Tensile strength: In order to satisfy the demand of the thinning by the formation of 780 or more MPa high intensity, set tensile strength to 780 or more MPa. 780 or more MPa of tensile strength are inevitably obtained by carrying out an organization to the organization which is mainly concerned with bainite.
[0035]The amount of paint baking hardening (the amount of BHs): The amount of BHs in 70 or more MPa this invention adds 2% of tensile strain, and is defined by increase of stock of yield stress after performing aging treatment of 170 **x20min. When the amount

of BHs sets to 70 or more MPa and it is used as parts, it appears as a difference of absorbed energy at the time of a form very much especially. That is, even if only the same quantity changes shockingly, more energies can be absorbed and the characteristic outstanding as an impact strength absorption member will be demonstrated. Thereby, if it is the same absorbed energy, closing-in-ization of a steel plate can be attained. By less than 70 MPa, such an effect is not fully demonstrated for the amount of BHs. The amount of BHs: In order to secure 70 or more MPa, it is preferred to control particle diameter more finely. Besides this, the amount of BHs increases by existence of a little martensite equality. However, also as for a tendency for the amount of BHs to decrease, it is so desirable for a certain reason to control the amount of BHs in consideration of these that yield strength (YS) is high.

[0036]Below, manufacturing conditions of this invention steel plate are explained. It is desirable to ingot molten steel of the above-mentioned presentation by the usually publicly known ingot methods, such as a converter and an electric furnace, and to consider it as steel stock, such as slab, by a continuous casting process. If it is made to solidify by a continuous casting process, macro segregation of an ingredient can be prevented. It replaces with a continuous casting process and it cannot be overemphasized that it is good also as an ingot making method, a thin-slabs casting process, etc.

[0037]After being cooled to a room temperature, it is once reheated, and it is rolled, or does not cool to a room temperature, but after the manufactured steel stock performs direct delivery rolling rolled after charging a heating furnace with the piece of ** and heating, or slight heat retaining, rolling rolled promptly is directly performed to it. When direct delivery rolling is performed, once terminating an austenite (gamma) -> ferrite (alpha) transformation from the homogeneity of an organization, and a viewpoint of a miniaturization, heating in gamma region again is desirable.

[0038]Cooking temperature of hot-rolling: The amount of undissolved Nb(s) heats the temperature steel stock in which the amount of undissolved Nb(s) becomes more than 0.003 % to the temperature which becomes more than 0.003 %. It is 1150 ** or less preferably. It is in the state which left undissolved Nb to some extent, and by performing rough rolling at low temperature comparatively, dynamic recrystallization arises during rough rolling and, as a result, a notably detailed and uniform hot-rolled organization can be obtained.

[0039]Although it is common to use the grain growth depressor effect by the dissolution Nb by making cooking temperature into an elevated temperature in conventional fine structure steel or precipitation-strengthening steel which added Nb etc. (for example, refer to JP,H6-145891,A) Uneven-izing of an organization becomes inescapable in this case. On the other hand, in this invention, the feature is especially that it carries out low-temperature heating for practical use of the deposit Nb. In the conventional high tensile steel, in order to reduce rolling load, it heated to a not less than 1250 ** elevated temperature, and deformation resistance was lowered, but since advance of dynamic recrystallization controls increase of deformation resistance in this invention, increase of rolling load is comparatively small also at low-temperature heating. The value quantified with the electrolytic extraction analysis method is used for un-dissolving as used in the field of this invention Nb about the sample which carried out water quenching from applicable cooking temperature. An electrolytic extraction analysis method carries out controlled-potential-electrolysis separation of the test sample for chemical analysis, and

is the method of quantifying with absorption photometry after filtering. (It is based on the steel-founders-society-of-America work shop steel analyzor meeting recommending method.) For example, Kiichi Narita: Iron, steel, 66 (1980), P211
in the elevated temperature which the amount of undissolved Nb(s) becomes [the cooking temperature of steel stock] in less than 0.003 %, or the temperature in which it exceeds 1150 **, gamma grain becomes big and rough quickly the first stage, and the homogeneity and miniaturization of a hot-rolled organization cannot be attained -- a mixed grain size -- ** As for the cooking temperature of steel stock, from a viewpoint of optimization of an organization, it is more preferably desirable to consider it as 1050 ** or less less than 1100 **. In order to reduce the load of rolling, heating more than 950 ** is preferred.

[0040]The finishing rolling appearance side temperature: Subsequently, rough rolling and finishing rolling are performed to the steel stock of which 950 -800 ** heating was done, and let it be a hot-rolled board. In order to consider the organization of a hot-rolled board as a uniform detailed organization, it is good to make the appearance side temperature of finishing rolling into the temperature requirement of 950 - 800 **. In less than 800 **, a hot-rolled board organization does expansion, the finishing rolling appearance side temperature becomes uneven, a processing organization remains in a steel plate edge part etc. further, and a moldability deteriorates. Since hot-rolled board organizing will become big and rough if the finishing rolling appearance side temperature exceeds 950 **, the organization of a cold-rolled annealing board (product sheet) becomes big and rough, and becomes a mixed grain size-ized tendency. For this reason, the finishing rolling appearance side temperature was limited to the range of 950-800 **. It is desirable to consider it as the range of 900 - 840 ** from a viewpoint of improvement in the mechanical property of a steel plate especially ductility, and the delayed fracture-proof characteristic.

[0041]Rolling-up temperature: A hot-rolled board which ended 700 - 400 ** finishing rolling is rolled round by coiled form. Rolling-up temperature of a hot-rolled board is limited to the range of 700 - 400 **. If rolling-up temperature exceeds 700 **, it becomes difficult to secure the homogeneity of construction material, and on the other hand, in less than 400 **, hot-rolled plate shape will be confused and a problem of a fall of line plate-leaping nature will occur with pickling of a post process, and cold rolling. For this reason, rolling-up temperature of a hot-rolled board was made into the range of 700 - 400 **. It is 650 - 450 ** preferably from a viewpoint of equalization of construction material.

[0042]Subsequently a hot-rolled board is cold-rolled and let it be a cold-rolled board. After pickling is performed to a hot-rolled board by a usual method, cold rolling is performed to it. As for rolling reduction of cold rolling, from a viewpoint of a miniaturization of an organization by cold-rolled recrystallization, it is preferred to consider it as not less than 40%. When a hot-rolled board is hard, hot-rolled board annealing can also be performed.

Annealing temperature of a cold-rolled board: As for more than 800 **, subsequently, a cold-rolled board is given annealing. Although more than recrystallization finish temperature performs annealing below 1000 **, in order to obtain a former organization for obtaining a uniform and detailed organization, it gives annealing above 800 **. In non-recrystallized structure, annealing temperature mixes in part by less than 800 **, and there is a problem that an organization below average crystal grain diameter 2.5 mum is

not obtained with a product sheet. On the other hand, if it exceeds 1000 **, an organization will become big and rough.

[0043]more than below 350 from annealing temperature **200 ** -- quenching cooling-rate [to a temperature region]: -- subsequently rapid cooling treatment is performed to the cold-rolled board heated by 15 - 150 **/s annealing temperature. It becomes difficult for the cooling rate in rapid cooling treatment to consider an organization as the organization which is mainly concerned with bainite in less than 15 **/[in s], and the tensile strength of 780 or more MPa is not obtained. On the other hand, if the cooling rate from annealing temperature exceeds 150 **/s, dispersion in strong will become large. A cooling rate is less than 100 **/s preferably. In this invention, cooling-rate:15 - 150 **/s is continuously quenched to the temperature region of more than below 350 **200 **. In the temperature whose quenching stop temperature is higher than 350 **, since a transformation to bainite is not completed, and bainite cannot be annealed, carbide cannot deposit big and rough and a desirable organization cannot be obtained, intensity falls. Quenching stop temperature leads to martensite-ization of an organization, and is not preferred at below 200 **. The "per continuum" is a meaning which is continued without discontinuation of a cooling process within [above-mentioned] quenching temperature and to say here.

[0044]The slow-cooling cooling rate after quenching: More than 15 ** / min perform [more than 15 ** / min] slow cooling processing below 300 **/min preferably following rapid cooling treatment. Below 200 ** performs slow cooling processing to the temperature of not less than 100 ** preferably. Tensile stabilization and equalization are obtained by performing slow cooling processing. A quenching organization is annealed for a cooling rate by less than 15 ** / min, and stretch flanging workability falls. When a cooling rate exceeds 300 **/min, the tendency for the delayed fracture-proof characteristic to fall is shown. For this reason, as for the cooling rate of the slow cooling processing after quenching, it is desirable that limit 15 ** / more than min, and below 300 **/min make it desirable. After slow cooling processing is completed at a temperature higher than 200 **, there is a problem that the delayed fracture-proof characteristic deteriorates.

[0045]200 In order for below ** to handle easily following slow cooling to temperature more than 100 ** preferably, it is preferred to quench to a room temperature again (it is called secondary quenching). As for starting temperature of secondary quenching, although conditions in particular of secondary quenching are not limited, it is preferred to consider it as 200 - 100 **. It is desirable to consider it as continuous rolling which joins the sheet bar which precedes hot finish rolling by the finishing mill ON side, and the sheet bar which carries out backward in this invention, and is rolled continuously. By considering it as continuous rolling, an unsteady part in a tip of a steel plate (steel strip in coil) and the back end is lost, and it becomes possible to perform hot-rolling stable covering an overall length of a steel sheet coil, and overall width. Thereby, sectional shape of a coil of a steel plate and dimensional accuracy improve, and, as a result, the homogeneity of **** after annealing also improves. Although it is preferred for junction of the sheet bar to precede and the sheet bar which carries out backward to be based on pressure welding, laser welding, electron beam welding, etc., it is not limited to these methods. Since tension can always be given to a steel plate even if it faces cooling after rolling by considering it as continuous rolling, good steel plate form can be held. Since it

is stabilized and plate leaping of the steel plate point can be carried out, lubricous rolling can be applied and it becomes extensible [a roll life] by reduction of rolling load, and reduction of roll face pressure.

[0046]In order to secure the homogeneity of the quality after annealing, in hot finish rolling, it is desirable to use sheet bar edge heaters, one side of a sheet bar heater, or both by the finishing mill ON side. It is desirable to heat a sheet bar edge part by sheet bar edge heaters so that it may finish eventually and the temperature gradient of the steel plate width direction in rolling may be 20 ** or less desirably. It is desirable to heat the sheet bar with a sheet bar heater so that the temperature fall of the tip of a steel plate and the back end may be compensated and a temperature gradient with a center section may be 20 ** or less desirably. Even if it uses simultaneously sheet bar edge heaters and a sheet bar heater, it is satisfactory in any way.

[0047]It is desirable to consider heat finishing rolling as lubricous rolling which uses a lubricating oil. In addition to reduction of rolling load, by considering it as lubricous rolling, improvement in steel plate form and dimensional accuracy and organization equalization of a steel plate board thickness direction can be attained.

[0048]

[Working example](Embodiment 1) The molten steel of the ingredient shown in Table 1 was ingoted with the converter, and it was considered as the slab of 220 mm thickness by the continuous casting process. This slab was used as the hot-rolled board on the hot-rolling conditions shown in Table 2. By the finishing mill ON side, hot finish rolling carried out melting pressure welding of the precedence sheet bar and the backward sheet bar, joined, and was made into continuous rolling. Furthermore, a sheet bar heater and sheet bar edge heaters were used by the finishing mill ON side, and equalization of sheet bar temperature was attained. It water-cooled with the hot run table after the end of hot-rolling before steel plate rolling up, and rolling-up temperature was adjusted. Lubricous rolling was performed in the finish rolling latter part. Subsequently, it cold-rolled to the hot-rolled board with pickling and the rolling reduction between the colds shown in Table 2, and was considered as the cold-rolled board. Then, annealing was given to these cold-rolled board at the temperature shown in Table 2, and after annealing, quenching, slow cooling, and secondary quenching were performed on condition of Table 2, and it cooled to the room temperature.

[0049]About the obtained cold-rolled annealing board, a macrostructure and microstructure examination for steel, a tensile test, a baking hardenability examination, a stretch-flanging-workability examination, the delayed fracture-proof sex test, the spot welding sex test, and a shock-proof examination were investigated. The amount of undissolved Nb(s) of the bottom is a value in fixed quantity in electrolytic extraction analysis about what heated and carried out water quenching of the specimen cut down from slab at the same temperature as slab cooking temperature.

[0050]A test method is shown below.

(1) While extracting macrostructure-and-microstructure-examination-for-steel each cold-rolled annealing rolling direction and the rolling direction, and the piece of a rectangular-directions blank test and observing the organization of the rolling direction section, and a rolling direction and a rectangular-directions section, the crystal grain diameter was measured. Measurement of the crystal grain diameter was measured about the overall thickness of board thickness in the rolling direction section, and a rolling direction and a

rectangular-directions section based on regulation of JIS G 0552, and was expressed with those average value.
(2) The JIS No. 5 test piece for tensile test was extracted from tensile test each cold-rolled annealing board, and tractive characteristics (the yield stress YS, tensile strength TS, elongation El) were investigated.
(3) The JIS No. 5 test piece for tensile test was extracted from baking hardenability examination each cold-rolled annealing board, after giving tensile prestrain 2%, 170 **x20min was heat-treated, subsequently the tensile test was done, the increase of stock of the yield stress before and behind heat treatment was calculated, and it was considered as the amount of BHs.
(4) To the specimen (board thickness x100 x100 mm) extracted from stretch-flanging-workability examination each cold-rolled annealing board. The hole of 10 mmphi is pierced and, subsequently it is the KAERI side (side which has "burr" in a sheared surface) about the cone punch of 60 degrees of vertical angles. Shaping which inserts from an opposite hand and extends a hole was performed, it asked for the bore diameter D (mm) when the crack penetrated board thickness, and the rate lambda of a marginal hole flare was calculated. The marginal hole spread rate lambda is lambda(%) =. It defines as {(D-10) /10} x100.
(5) The punch of 33 mmphi and a diaphragm dice (KURAIANSU: +10% of board thickness) with a shoulder radius of 4 mm were used for the disk of 59 mmphi extracted by die cutting from delayed fracture-proof sex-test each cold-rolled annealing board, deep-drawing shaping was given, it was immersed for one week into pure water after that, and the existence of the crack was observed. The case where there was no generating of x and a crack about the case where generating of a crack is seen was made into O.
(6) Spot welding sex-test each cold-rolled annealing boards were piled up, spot welding was carried out by the following condition, the 25-mm-wide shearing tensile test was created based on JIS Z 3140, and the shearing tensile strength of the spot welding part was measured. The shearing tensile strength of the weld zone increased in proportion to the tensile strength of base metal, and the case where the fracture had not reached in the nugget was evaluated as O. When there was strength reduction, the case where the fracture had reached in the nugget was made into x.
[0051]Spot welding Condition:(a) electrode: -- 6mmphiCF (b) resistance-welding-time: -- initial welding-pressure [of 8 cycle (c)]: -- 250kgf (d) retention time: -- 15 cycle (e) welding current: -- dust generating directly under current (7) shock-resistance examination each cold-rolled annealing board. And using the same test piece for tensile test as the examination of (6) per spot welding part (2), high-speed tension of speed-of-testing:7m /s was carried out with the hydraulic-servo type high-speed tension tester, and breaking strength and a fracture form were investigated.
[0052]The result of each examination is shown in Table 3.
[0053]
[Table 1]

鋼No	化学成分 (wt%)													備考
	C	Si	Mn	P	S	Al	N	Nb	Ti	B	V	Cu, Ni, Cr, Mo	Ca	
A	0.08	0.02	3.00	0.01	0.002	0.05	0.004	0.045	—	—	—	—	0.0015	本発明例
B	0.08	0.10	2.70	0.01	0.001	0.04	0.003	0.040	—	—	—	Cr:0.15	—	本発明例
C	0.15	0.02	2.90	0.01	0.002	0.04	0.002	0.009	0.015	—	0.008	Cu:0.05	—	本発明例
D	0.08	0.70	2.00	0.01	0.002	0.04	0.005	0.025	—	0.0015	—	—	—	本発明例
E	0.15	0.25	1.80	0.01	0.001	0.04	0.003	0.009	—	—	—	Cr:0.02, Mo:0.02	0.0025	本発明例
F	0.08	0.03	3.10	0.01	0.002	0.04	0.002	0.040	—	—	—	—	—	本発明例
G	0.08	0.15	1.80	0.01	0.001	0.05	0.002	—	—	—	—	—	—	比較例
H	0.08	0.02	1.00	0.01	0.003	0.04	0.002	0.040	—	—	—	—	—	比較例
I	0.08	0.02	2.80	0.01	0.002	0.04	0.003	0.100	—	—	—	—	—	比較例
J	0.08	0.02	3.80	0.01	0.002	0.05	0.003	0.030	—	—	—	—	—	比較例
K	0.18	0.05	1.60	0.01	0.002	0.04	0.004	0.050	—	—	—	Ni:0.20	—	本発明例

[0054]
[Table 2]

鋼板No	鋼No	熱間圧延								冷延	焼鈍	焼鈍後冷却				備考
		加熱温度 ℃	未固溶Nb量 %	連続圧延	ヒータ使用	仕上げ圧延出側温度 ℃	巻取り温度 ℃	熱延板仕上厚 mm		圧下率 %	焼鈍温度 ℃	急冷		徐冷	2次急冷	
												冷却速度 ℃/s	停止温度 ℃	冷却速度 ℃/min	開始温度 ℃	
1	A	1030	0.026	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例
2	B	1030	0.025	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例
3	C	1030	0.008	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例
4	D	1030	0.016	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例
5	E	1030	0.007	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例
6	F	1030	0.024	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例
7	G	1030	0	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	比較例
8	H	1030	0.023	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	比較例
9	I	1030	0.055	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	比較例
10	J	1030	0.019	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	比較例
11	K	1030	0.030	適用	使用	適用	840	550	2.4	58	840	40	250	25	180	本発明例

[0055]
[Table 3]

鋼板No	組織 *			引張特性			曲げ性	伸びフランジ性	溶接性	耐遅れ破壊性	耐衝撃性		備考
	平均粒径 μm	主相	副相	YS MPa	TS MPa	El %	曲率 MPa	限界穴広げ率 λ %	スポット溶接性		母板 破断強度 MPa	スポット溶接部 破断形態	
			種類 面積率 %										
1	2.2	B	F<5	607	1020	16	150	45	○	○	1215	○	本発明例
2	1.8	B	F, γ<3	910	1125	15	170	43	○	○	1325	○	本発明例
3	1.7	B	F, γ<3	821	1220	15	170	42	○	○	1410	○	本発明例
4	2.3	B	F:5	893	1150	16	155	45	○	○	1340	○	本発明例
5	1.9	B	M:5	743	990	17	160	47	○	○	1160	○	本発明例
6	2.2	B	M, γ<7	610	1015	15	140	43	○	○	1210	○	本発明例
7	4.5	B	F:8, γ:5	570	750	18	75	20	×	×	920	×	比較例
8	39	B	F:25, M:2	530	720	15	55	28	○	○	915	○	比較例
9	29	B	F:10	720	950	10	58	27	○	○	1130	×	比較例
10	2.5	B	M:25	1020	1310	11	140	15	×	×	920	×	比較例
11	2.2	B	F:5, M:5, γ:5	735	980	18	165	45	○	○	1165	○	本発明例

*) B：ベイナイト、F：フェライト、
M：マルテンサイト、γ：残留オーステナイト

[0056]Each example of this invention is the high intensity of 990 or more MPa of tensile strength, and is as large as 155 or more MPa, and Table 3 shows excelling in stretch flanging workability, weldability, delayed fracture-proof nature, and shock resistance. [of the amount of baking hardening] As compared with this, either the intensity or the amount of baking hardening of the comparative example which separates from the range of this invention is low, or stretch flanging workability, weldability, delayed fracture-proof nature, and shock-proof either have deteriorated.
It did not excel in all these characteristics.

(Embodiment 2) It was considered as the hot-rolled board on the hot-rolling conditions which the ingredient organization of those other than the steel No and A which are shown in Table 1, and Ca shows in Table 4 using the same slab (Ca additive-free). in some boards, by the finishing mill ON side, melting pressure welding of the precedence sheet bar and the backward sheet bar is carried out, it joins, and heat finishing rolling is rolled -- continuous rolling was carried out. About one copy, lubricous rolling was performed in the finishing rolling latter part. Subsequently, it cold-rolled to the hot-rolled board with pickling and the rolling reduction between the colds shown in Table 4, and was considered as the cold-rolled board. Then, annealing was given to these cold-rolled board at the temperature shown in Table 4, and after annealing, quenching, annealing, and secondary quenching were performed on condition of Table 4, and it cooled to the room temperature.
[0057]About the obtained cold-rolled annealing board, a macrostructure and microstructure examination for steel, a tensile test, a baking hardenability examination, a stretch-flanging-workability examination, the delayed fracture-proof sex test, the spot welding sex test, and a shock-proof examination were investigated like Embodiment 1. Those results are shown in Table 5.

[0058]
[Table 4]

鋼板No	鋼No	熱間圧延								冷延	焼鈍	焼鈍後冷却			
		加熱温度 ℃	未固溶Nb量 %	連続圧延	ヒータ使用	潤滑圧延	仕上げ圧延出側温度 ℃	巻取り温度 ℃	熱延板仕上厚 mm	圧下率 %	焼鈍温度 ℃	急冷		緩冷	2次急冷
												冷却速度 ℃/s	停止温度 ℃	冷却速度 ℃/min	開始温度 ℃
2－1	A	1050	0.025	適用	－	－	855	550	2.4	58	840	25	275	30	180
2－2		1030	0.027	－	－	－	840	550	2.6	62	850	27	250	25	100
2－3		1080	0.020	－	－	－	850	580	2.4	58	820	25	300	25	140
2－4		1060	0.015	－	－	－	850	530	2.6	62	840	25	275	33	140
2－5		1020	0.028	－	使用	－	820	500	2.4	58	805	35	300	25	160
2－6		1020	0.028	－	－	－	860	450	2.4	58	840	20	225	30	180
2－7		1010	0.030	－	－	－	850	600	2.4	58	840	25	250	30	100
2－8		1180	<0.001	適用	使用	適用	880	550	2.6	62	870	20	300	30	180
2－9		1050	0.025	適用	使用	適用	750	520	2.6	62	805	20	260	30	100
2－10		1040	0.026	適用	使用	適用	850	750	2.6	62	800	20	260	25	120
2－11		1050	0.026	適用	使用	適用	850	530	2.6	62	790	30	260	30	120
2－12		1050	0.025	適用	使用	適用	840	550	2.6	58	820	7	260	30	120
2－13		1050	0.025	適用	使用	適用	850	550	2.6	62	820	20	400	38	120
2－14		1040	0.026	適用	使用	適用	850	550	2.6	62	830	20	270	500	120
2－15		1050	0.025	－	－	－	850	550	2.6	62	830	180	270	30	120
2－16		1050	0.025	－	－	－	850	550	2.6	62	830	20	150	30	120
2－17		1050	0.025	－	－	－	850	550	2.6	62	830	20	270	10	120
2－18		1090	0.018	適用	－	適用	870	620	2.6	62	850	50	325	20	150
2－19		1070	0.022	適用	使用	適用	870	640	2.6	62	850	80	300	250	130

[0059]
[Table 5]

鋼板No	組織 *				引張特性			BH性	伸びフランジ性	溶接性	耐遅れ破壊性	耐衝撃性		備考
	平均粒径 μm	主相	副相		YS	TS	El	BH量	限界穴拡げ率 λ %	スポット溶接性		母板	スポット溶接部	
			種類	面積率 %	MPa	MPa	%	MPa				破断強度 MPa	破断形態	
2－1	2.1	B	－		650	1025	16	135	48	○	○	1210	○	本発明例
2－2	1.9	B	－		720	1180	15	145	47	○	○	1360	○	本発明例
2－3	1.9	B	F	4	590	985	18	120	47	○	○	1170	○	本発明例
2－4	1.8	B	－		725	1100	16	150	45	○	○	1280	○	本発明例
2－5	1.2	B	M	4	710	995	16	170	49	○	○	1180	○	本発明例
2－6	1.8	B	M	5	920	1220	14	145	47	○	○	1400	○	本発明例
2－7	1.7	B	－		815	1090	14	150	47	○	○	1278	×	本発明例
2－8	4.7	B	F	4, P 15	525	1050	12	65	23	×	×	1233	×	比較例
2－9	4.4	B	F	3	520	1005	13	55	24	×	×	1200	×	比較例
2－10	4.2	B	F	7, P 2	510	1005	12	45	22	○	○	1180	×	比較例
2－11	2.8	B	－		650	1210	13	55	15	×	×	1300	×	比較例
2－12	4.5	B	F	20	530	750	12	40	20	○	○	900	○	比較例
2－13	4.4	B	F	15	580	770	15	55	25	×	○	800	×	比較例
2－14	2.6	B	－		900	1220	11	50	29	○	×	1290	×	比較例
2－15	2.0	B	M	25	983	1310	13	60	15	×	×	1350	×	比較例
2－16	2.0	B	M	27	968	1290	12	145	10	×	×	1280	×	比較例
2－17	2.2	B	F	15, γ 7	731	950	17	56	38	○	○	970	×	比較例
2－18	1.9	B	F	5	595	985	18	130	45	○	○	1170	○	本発明例
2－19	1.9	B	F	5, γ 2	605	985	17	135	45	○	○	1180	○	本発明例

*) B：ベイナイト、F：フェライト、P：パーライト
M：マルテンサイト、γ：残留オーステナイト

[0060]From Table 5, each example of this invention is the high intensity of 985 or more MPa of tensile strength, and is also the amount of baking hardening. It is as large as 85 or more MPa, and it turns out that it excels in stretch flanging workability, weldability, delayed fracture-proof nature, and shock resistance. As compared with this, either the intensity or the amount of baking hardening of the comparative example which separates from the range of this invention is low, or stretch flanging workability, weldability, delayed fracture-proof nature, and shock-proof either have deteriorated.
It did not excel in all these characteristics.

[0061]
[Effect of the Invention]According to this invention, it has the high intensity as for which tensile strength 780MPa exceeds with a comparatively small alloy addition, And good weldability in an outstanding moldability, spot welding, etc., such as stretch-flanging nature and bending nature, A base-metal part has the outstanding shock resistance which has the impact strength absorption feature which balanced intensity also in the weld zone from the first, and can provide the high intensity cold-rolled steel sheets which have still higher paint baking hardenability and the outstanding delayed fracture-proof characteristic. this invention steel plate can expect that contributing to the improvement in safety greatly is a weight saving of a car as a reinforcement member of cars, such as bumper parts and an impact beam, and does a marked effect so industrially. Not only cold rolled sheet steel but the application to various kinds of plating steel plates (electroplating, hot-dip coating) is also possible for the steel plate of this invention.

==========